

INNOVATION. PERFORMANCE. SAVINGS.  
ENERGY STAR® Makes It Simple.

An ENERGY STAR qualified LED lighting product will last at least 22 years based on typical household use.



U.S. DEPARTMENT OF ENERGY  
ENERGY STAR® QUALIFIED LED LIGHTING  
2008 PARTNER RESOURCE GUIDE



## SECTION I : CONSUMER INFORMATION

This document is designed to help partners understand and promote LED lighting products that meet the ENERGY STAR criteria established by the U.S. Department of Energy (DOE). You are free to use any of its messaging and graphics to promote ENERGY STAR qualified products on Web sites, print advertisements, in-store promotional materials, and other marketing materials. This document is divided into two sections:

- Section I includes consumer messaging on product features and benefits, as well as fun facts.
- Section II summarizes the market outlook for ENERGY STAR LED products.

### ADVANCED TECHNOLOGY

ENERGY STAR qualified LED lighting products are integrated systems with the light source built into the fixture. Qualified lighting products contain a number of high-powered LEDs arranged inside a fixture to efficiently produce high-quality white light.



LEARN MORE AT  
[energystar.gov](http://energystar.gov)

ENERGY STAR is a government-backed program that helps consumers identify the most energy efficient products.



## DID YOU KNOW?

In the next 20 years, LED lighting in the United States could:<sup>1</sup>

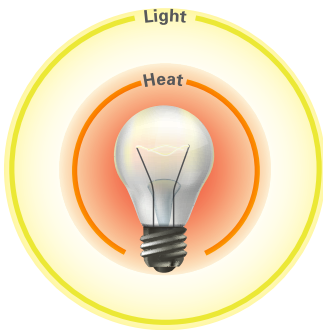
- Reduce electricity demands from lighting by 33 percent by 2027.
- Eliminate 570 million metric tons of carbon emissions
- Avoid 40 new power plants.
- Save as much as \$265 billion in energy costs.

## WHAT ARE LEDS?

LED stands for light-emitting diode. LEDs are small light sources that become illuminated by the movement of electrons through a semiconductor material.

LEDs are part of a family of lighting technologies called solid-state lighting (SSL). This family also includes OLEDs (organic light emitting diodes). OLEDs (pronounced OH-leds) consist of sheets of carbon-based compounds that glow when a current is applied through transparent electrodes. While not yet market ready, OLEDs are like a thin film on a wall or ceiling that illuminates a room. Like LEDs, OLED technology is advancing rapidly.

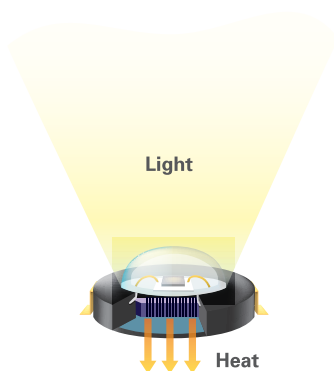
## LESS HEAT, MORE LIGHT



**Incandescent bulbs** create light by passing electricity through a metal filament until it becomes so hot that it glows. Incandescent bulbs release about 90 percent of their energy as heat.



In a **compact fluorescent light bulb (CFL)**, an electric current is driven through a tube containing gases. This reaction produces ultraviolet light that gets transformed into visible light by the phosphor coating inside the tube. A CFL releases about 80 percent of its energy as heat.



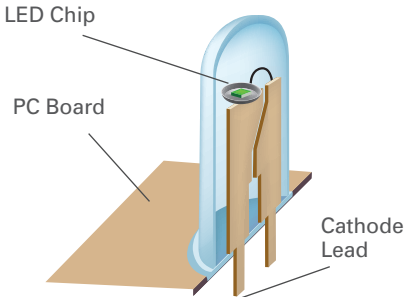
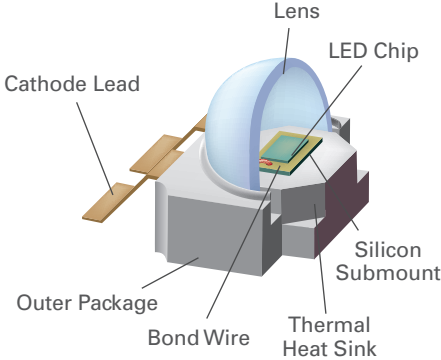
In **LED lighting products**, the movement of electrons through a semiconductor material illuminates the tiny light sources we call LEDs. A small amount of heat is released backward, into a heat sink, in a well-designed product. LEDs are cool to the touch.

## BASIC PARTS OF LED LIGHTING

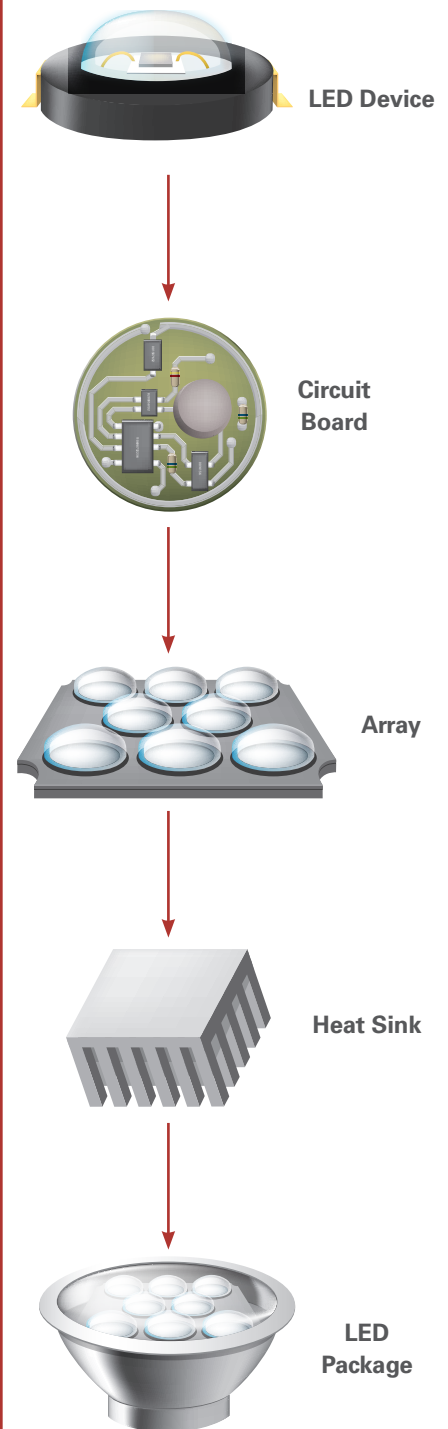
LED lighting starts with a tiny chip (most commonly about one square millimeter) comprised of layers of semi-conducting material. The chip or chips are mounted on heat-conducting material called a heat sink and usually enclosed in a lens. The resulting device, typically around 7 to 9 millimeters on a side, can be used separately or in arrays. LED devices are mounted on a circuit board, which can be programmed to include lighting controls such as dimming and time sensing. The circuit board is mounted on another heat sink to manage the heat from all the LEDs in the array. The system is then encased in a lighting fixture, architectural structure, or even a “light bulb” package.

## THE VALUE OF DOE ENERGY STAR QUALIFIED LED LIGHTING

With the rapid advancement of LED technology, it's important to remember that not all LED lighting products are created equal. The ENERGY STAR label gives consumers confidence that an LED product meets strict efficiency and performance criteria established by DOE. These products are designed to perform as well as or better than traditional lighting in terms of brightness, light quality, and energy efficiency. They also come with a minimum three-year manufacturer warranty.

LOW-POWERED LEDs	HIGH-POWERED LEDs
 <p>LED Chip PC Board Cathode Lead</p> <p>Low-powered LEDs are used for indication, such as an exit sign, a green power button on a computer, or a red blinking light on a video camera.</p>	 <p>Lens LED Chip Cathode Lead Outer Package Bond Wire Thermal Heat Sink Silicon Submount</p> <p>High-powered LEDs are used for general lighting. ENERGY STAR qualified LED lighting uses multiple high-powered LEDs inside a fixture to produce white light.</p>

## WHAT'S INSIDE?





Never change another light bulb!

## SAVE ENERGY

- ENERGY STAR qualified LED lighting uses at least 75 percent less energy than incandescent lighting.
- ENERGY STAR qualified LED lighting is at least as efficient as fluorescent lighting.

## SAVE TIME

- Stop changing light bulbs! Qualified LED lighting products integrate the light source and the fixture, meaning you'll never have to change a bulb.
- ENERGY STAR qualified LED lighting for homes lasts at least 25 times longer than incandescent lighting, and 2.5 times longer than typical fluorescent lighting.<sup>2</sup>
- Products made for the commercial sector last at least 35 times longer than incandescent lighting, and at least 3.5 times longer than typical fluorescent lighting.<sup>3</sup>




## LIGHT BEAUTIFULLY

- ENERGY STAR qualified LED lighting provides a clear and consistent shade of white light throughout the lifetime of the fixture.
- Superior light quality won't harm art, fabric, or other materials.

## ENJOY BETTER DESIGN AND PERFORMANCE

- Superior directionality allows for precision lighting.
- Compact, low-profile fixtures offer greater flexibility in placement.
- Durability ensures consistent performance and rare breakage.
- Performance is enhanced in cold temperatures, making qualified LEDs perfect for outdoor use.
- LEDs turn on instantly; there is no warm-up time.
- Dimming, timing, and color controls allow for reliable custom settings when used with compatible controls.
- LEDs produce far less heat than incandescents. This reduces air conditioning needs.

## ANNUAL OPERATING COST COMPARISON FOR RECESSED DOWN LIGHTING

LIGHT SOURCE	LIGHT OUTPUT (LUMENS)		WATTS	LIFETIME (HOURS)	ANNUAL OPERATING COSTS <sup>1</sup>
	USEFUL LIGHT	WASTED LIGHT			
 Incandescent bulb	575	575	75.0	1,000	\$8.87
 Compact fluorescent light bulb (CFL)	575	575	20.0	10,000	\$2.37
 ENERGY STAR qualified LED lighting	575	0	16.5	25,000 or 35,000	\$1.95

## LIFETIME COMPARISON OF LIGHT SOURCES

RESIDENTIAL	COMMERCIAL
<p>25</p>  <p>2.5</p>   <p>Incandescent Light Bulbs      CFLs      LED</p>	<p>35</p>  <p>3.5</p>   <p>Incandescent Light Bulbs      CFLs      LED</p>

## ADDING UP ENERGY EFFICIENCY

When designed to be used in homes, ENERGY STAR qualified LED light fixtures last for at least 22 years without ever needing a bulb change! You would need 25 incandescents or 2.5 CFLs to last that long.<sup>5</sup>

In commercial uses, ENERGY STAR qualified LED light fixtures can last for more than 10 years without ever needing a bulb change! Over that time, you would use 35 incandescent bulbs or 3.5 pin-base CFLs.<sup>6</sup>

**AREN'T ALL LED LIGHTS HIGHLY EFFICIENT AND LONG-LASTING?**

Unfortunately, no. While LED lighting technology is unsurpassed in its efficiency, using LEDs to create stable white light for general lighting presents new challenges. Some manufacturers claim greater efficiency and durability than their products deliver. To be assured that LED products perform as well as the packaging claims, choose an ENERGY STAR qualified model.

**ENERGY STAR QUALIFIED LED LIGHTING PRODUCT TYPES**

LED technology is best suited to certain types of lighting applications where the performance of the LED product equals or exceeds that of existing lighting options.

The DOE ENERGY STAR criteria cover requirements for LED products used for general illumination, including those with a significant decorative function. The criteria apply to both residential and commercial products.

Currently, DOE ENERGY STAR qualified LED lighting covers fixtures, but not LED bulbs designed to replace regular screw-base incandescent bulbs. LED bulbs will be included in the program when their performance meets that of current light bulbs. DOE will expand the ENERGY STAR program to include other lighting applications as LED technology improves.

TYPES OF ENERGY STAR QUALIFIED LED LIGHTING	
<div>OUTDOOR PORCH LIGHTS</div> 	<ul style="list-style-type: none"><li>■ Reliable light, when and where you need it, with little energy use.</li><li>■ Directional lighting reduces light pollution.</li><li>■ At least 35 times longer lasting than incandescent lights.<sup>7</sup></li><li>■ Durable and dependable in cold temperatures.</li></ul>
<div>OUTDOOR STEP LIGHTS*</div> 	<ul style="list-style-type: none"><li>■ Safety without the added energy cost.</li><li>■ Light where you need and want it most.</li><li>■ Low profile models, allow inconspicuous lighting.</li><li>■ Long lasting and durable.</li></ul>
<div>OUTDOOR PATHWAY LIGHTS*</div> 	<ul style="list-style-type: none"><li>■ Safety without the added energy cost.</li><li>■ Low profile models, allow inconspicuous lighting.</li><li>■ Long lasting and durable.</li></ul>
<div>SHELF-MOUNTED AND TASK LIGHTS*</div> 	<ul style="list-style-type: none"><li>■ Accent and task lighting with clarity.</li><li>■ Great for illuminating work spaces and showcases.</li><li>■ Won't damage light-sensitive items.</li><li>■ Thin, low-profile design, allows inconspicuous lighting.</li></ul>
<div>UNDER-CABINET KITCHEN LIGHTS</div> 	<ul style="list-style-type: none"><li>■ Fully illuminate countertops with bright and clear white light.</li><li>■ Put the light where you really need it.</li><li>■ Thin, low-profile design, which allows inconspicuous lighting.</li></ul>
<div>PORTABLE DESK LAMPS*</div> 	<ul style="list-style-type: none"><li>■ Clear, brilliant light where you need it, without the heat.</li><li>■ Small, low-profile design.</li><li>■ Won't damage light-sensitive items.</li></ul>
<div>RECESSED DOWN LIGHTS*</div> 	<ul style="list-style-type: none"><li>■ No wasted energy or light, unlike bulbs inside a recessed can.</li><li>■ Dimmable when paired with a compatible dimmer switch.</li><li>■ Reduces cooling costs, by producing far less heat.</li><li>■ Lasts at least 25 times longer than incandescent lights - no more bulb changing.<sup>8</sup></li></ul>

The DOE ENERGY STAR LED lighting program includes the residential and commercial products shown above. All qualify for residential use, while those with an asterisk (\*) also qualify for commercial use.

DRIVING CONSUMER DEMAND

Increasing sales of ENERGY STAR qualified LED lighting requires effective consumer education to build confidence in the technology. Educating consumers is a multi-step process, including

- **AWARENESS:** Consumers discover ENERGY STAR qualified LED lighting as an alternative to traditional residential and commercial lighting.
- **KNOWLEDGE:** Consumers learn how ENERGY STAR qualified LED lighting may benefit them.
- **ACTION:** Consumers begin to rely on the ENERGY STAR label to find quality products.

DOE recommends that partners use plain language in marketing materials to introduce ENERGY STAR qualified LED lighting to consumers. Messaging should build on consumers’ existing knowledge of lighting products to ease the learning curve. In particular, partners should avoid jargon that is specific to the industry.



The U.S. Department of Energy estimates that at least 500 million recessed down lights are installed in U.S. homes and more than 20 million more are sold each year. LED technology can decrease recessed down light energy use by 75 percent or more.

LED LIGHTING TERMINOLOGY	
USE REGULARLY	LIMIT USE / AVOID
LED	SSL
Fixture	Luminaire
Brightness or light output	Lumens or luminous flux
Efficiency	Luminaire efficacy
Color or light color or shade of white light	Correlated color temperature (CCT)
Color accuracy or true color	Color rendering index (CRI)

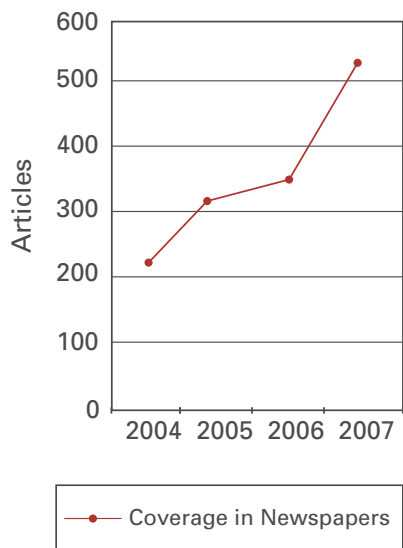
DRIVING DEMAND IN THE COMMERCIAL SECTOR

In the early stages of market development, the low operating costs of ENERGY STAR qualified LED lighting products may be most appealing to commercial consumers.

Commercial consumers are likely to have greater awareness of advanced lighting technologies and have more lighting technology alternatives at their disposal. Commercial consumers may therefore be drawn to more detailed information that will increase their knowledge of the benefits of LED lighting and the value of the ENERGY STAR label, such as the potential to earn points for LEED certification.

## SECTION II : MARKET OUTLOOK

### AWARENESS OF LEDS



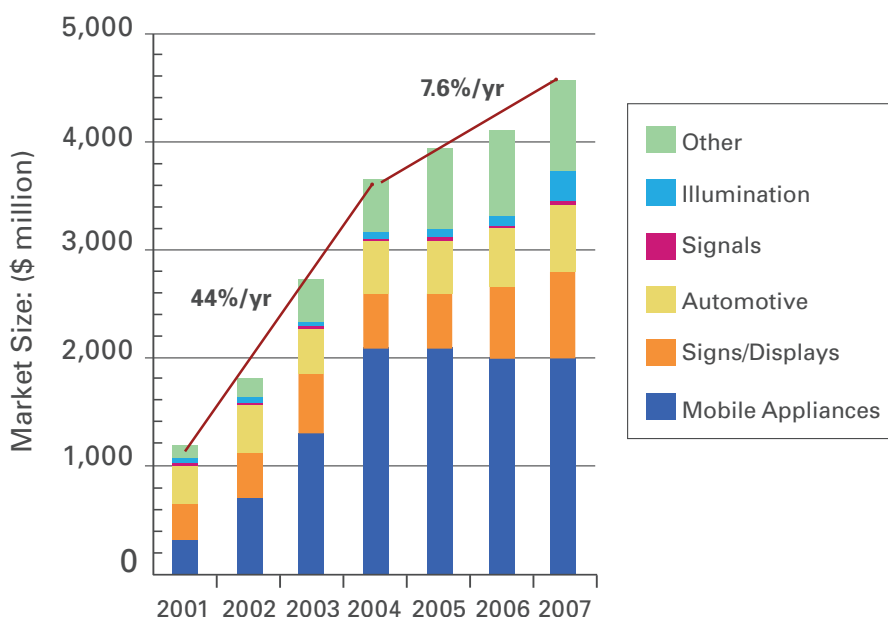
Growing awareness of LEDs is reflected in the increase in mainstream media coverage of the technology. In 2006, U.S. newspapers published 345 articles that mentioned LED lighting. In 2007, media coverage swelled to 534 articles, an increase of 55 percent.<sup>11</sup>

The market share of LEDs for general lighting is relatively small, but it has expanded significantly in recent years and is expected to grow exponentially as the technology continues to improve. The figure below demonstrates the development of the LED lighting market and the increasing size of the illumination market for LEDs.

In 2007 alone, the global market for general LED lighting grew by approximately \$125 million. Strategies Unlimited forecasts that the total market for LEDs will grow at an annual rate of 37 percent, reaching about \$1 billion by 2011.<sup>9</sup>

DOE predicts that the area of greatest potential growth, particularly in the introductory stages of LED lighting, lies with commercial consumers. One company forecasts that LEDs will produce at least 75 percent of commercial lighting in the United States by 2030.<sup>10</sup>

### RECENT MARKET HISTORY



Source: *Strategies Unlimited*, 2008.

## DOE ENERGY STAR LED LIGHTING CRITERIA

DOE has made a long-term commitment to the development and market introduction of solid-state lighting (SSL), which includes LED lighting. DOE recognizes the need for a coordinated approach that guides technology advances from the laboratory to the marketplace.

DOE's ENERGY STAR LED lighting criteria address product quality and efficiency, helping ensure that residential and commercial consumers have a positive experience with this new technology. The criteria consider four features of LED lighting:

- Luminaire efficacy. (The efficiency of the light that leaves the fixture).
- Minimum light levels that match existing technology.
- Limited correlated color temperature.
- Industry-accepted test procedures.

To ensure product quality, the criteria will only apply to the most market-ready applications. In 2011, DOE will expand the ENERGY STAR program to include a wider variety of LED applications for general lighting.

DOE's ENERGY STAR criteria require LED products to deliver at least 70 percent of initial light output for the minimum number of hours specified below:

- Residential indoor: 25,000 hours
- Residential outdoor: 35,000 hours
- All commercial: 35,000 hours

The lifetime requirement for residential indoor products is lower because of the shorter operating cycles typical of residential indoor applications. For example, residential indoor lights are on an average of three hours per day, but commercial lighting products are generally used at least ten hours a day.

Please visit [www.energystar.gov](http://www.energystar.gov) to review detailed criteria specifications.



### DID YOU KNOW?

ENERGY STAR qualified LED lighting products for outdoor use are required to last at least 35,000 hours. Based on normal use of ten hours per day, that's about 10 years.

## END NOTES

<sup>1</sup> Numbers based on analysis by D&R International.

<sup>2</sup> Estimated lifetime based on a 25,000-hour LED product, a 1,000-hour incandescent product, and a 10,000-hour fluorescent product.

<sup>3</sup> Estimated lifetime based on a 35,000-hour LED product, a 1,000-hour incandescent product, and a 10,000-hour fluorescent product.

<sup>4</sup> Operating costs for recessed down lights are annual and assume three hours of use per day for typical residential use, and an average utility rate of \$0.108 per kWh.

<sup>5</sup> Lifetime assumptions based on a 25,000-hour residential LED product, a 1,000-hour incandescent product, and a 10,000-hour fluorescent product, and an average use of 3 hours per day.

<sup>6</sup> Lifetime assumptions based on a 35,000-hour commercial LED product, a 1,000-hour incandescent product, and a 10,000-hour fluorescent product, and an average use of 10 hours per day.

<sup>7</sup> Lifetime assumptions based on a 35,000-hour residential outdoor LED product, and a 1,000-hour incandescent product.

<sup>8</sup> Lifetime assumptions based on a 25,000-hour residential LED product, and a 1,000-hour incandescent product.

<sup>9</sup> From the webcast presentation, "Market Trends and Emerging Applications," by Robert V. Steels, Director of Optoelectronics, Strategies Unlimited, July 30, 2008. [www.ledsmagazine.com](http://www.ledsmagazine.com).

<sup>10</sup> "The Market for High-Brightness LEDs in Lighting: Application Analysis and Forecast – 2007," January 2007.

<sup>11</sup> Based on a review by D&R International using Lexis Nexis databases of the use of "LED" and "lighting" in U.S. newspapers from 2004 to 2007.



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